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History, Culture, Learning, and Development

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The authors report a diachronic investigation of cultural apprenticeship, creativity, and cognitive representation in a Zinacantec Maya community of Chiapas, Mexico. Focusing on the culturally central domain of weaving, they explore the implications of an ecocultural transition from agriculture to commerce for learning and development. Their studies cover 24 years and explore the implications of historical change in two generations of Zinacantec Maya children. The first wave was studied in 1969 and 1970. The next generation was studied in 1991 and 1993; it comprised mainly daughters and sons, nieces and nephews, and godchildren of the first generation. The results show that in the space of a single generation, weaving apprenticeship moved from a more interdependent to a more independent style of learning, woven textiles changed from a small stock of defined patterns to widely varied and innovative patterns, and cognitive representation of woven patterns became less detailed and more abstract.

We feel very privileged to be part of the special issue honoring and remembering Dr. Ruth Munroe. In the history of our field, she was



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a pioneering figure who introduced a cross-cultural approach to all aspects of human development into the field of cross-cultural psychology. With her husband, Dr. Robert L. Munroe, she blazed a path for fruitful collaboration between members of anthropology and psychology departments.

There are a number of important ways in which the research that we will present in this article can be considered the fruit of intellectual and empirical seeds planted by Dr. Munroe, in collaboration with her husband. First, the Munroes carried out longitudinal research, making connections between two different parts of the life cycle in Kenya. Second, they made cross-cultural investigations of children's work, highlighting the importance of work as an important shaper of children's development and the sensitivity of children's work to larger ecological forces. Third, they realized the

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potential impact of economic factors on cognitive performance and were able to test this relationship through controlled cross-cultural study. The research presented in this article stands on the shoulders of Ruth Munroe's collaborative research program in all three respects: It is longitudinal, it centers on children's work, and it connects larger economic forces with pathways of socialization and human development.

In human history, there have been three major ecological adaptations: hunting and gathering, agriculture, and commerce with advanced technology. Like the Munroes, we hypothesize that each ecology emphasizes a different set of skills, different developmental pathways, and different processes of socialization or informal education. Human development is an adaptation to two types of characteristics: the characteristics of the surrounding ecology, such as the climate and type of land available, and the characteristics of cultural practices that arise as adaptations to those ecologies (Weisner, 1984). It follows that different socialization patterns are necessary to prepare children for a changing environment or for an environment that is different from the one in which parents themselves were raised. In this first diachronic study of the impact of ecocultural changes on the practices of informal education, we demonstrate how the distal variable of historical epoch affects proximal variables in the teaching of weaving in a Zinacantec Maya community, resulting in changed teaching practices from one generation to the next. We also investigate a closely related change from a small, closed stock of woven patterns to a new variety of woven patterns, with constant innovation. Last, we show how ecocultural variability in subsistence patterns affects the representation of cultural artifacts.

INFORMAL EDUCATION

Processes of informal education have been documented by many researchers in recent years (e.g., Greenfield, 1984; Greenfield & Lave, 1982; Lave & Wenger, 1990; Rogoff, 1990). We have come to understand informal education as an apprenticeship process that expresses cultural goals. Past studies of informal education have focused on scaffolding processes from parent to child in the teaching of everyday tasks (Rogoff, Mistry, Göncü, & Mosier, 1993), and the apprenticeship of crafts such as carpentry, tailoring (Lave & Wenger, 1990), and weaving (Childs & Greenfield, 1980). No study

has yet considered how processes of apprenticeship change with changes in the ecocultural environment.

The research presented in this article investigates the historical transition from agriculture to commerce, focusing on the implications of this transition for learning and development. We focus on three areas of learning and development: the creation of artifacts, apprenticeship, and the symbolic representation of those artifacts. The data are taken from research conducted with two generations of participants in Nabenchauk, a Zinacantec Maya hamlet in the highlands of Chiapas, Mexico.

HISTORY, CULTURE, AND SOCIALIZATION

Our investigation also relates to larger questions concerning the relationship between history, culture, and the socialization of the individual. This relationship is central to the field of cultural psychology and, particularly, to the sociohistorical approach. Culture at any given moment is the product of historical change, as well as a reflection of cultural constancy and conservatism.

The process of cultural transmission from one generation to another links culture at one historical moment with culture at another historical moment. What is called cultural transmission from the point of view of society is called socialization from the point of view of the family, and development from the point of view of the individual. Socialization is intrinsically future oriented; it prepares children for an adulthood that has not yet arrived. It follows that changing socialization patterns should be a key component of the psychological adaptation to social change. However, an important question in conditions of ecocultural change is, do parents merely repeat the socializing process that they underwent as children? Or do parents develop new methods and processes as societal conditions—in this case, economic conditions—change? And what, if any, are the consequences of such changes in socialization for the development of children?

The sociohistorical research tradition, derived from Vygotsky (1962, 1978), emphasizes that development is constructed through social interaction, cultural practices, and the internalization or cognitive appropriation of symbolic tools (Saxe, 1990). Although the historical dimension of cultural practices and symbolic tools is emphasized—that is, we understand how the practices and tools fit with the development of the culture itself over time—the

developmental implications of historical change for those cultural practices and symbolic tools have not been studied directly. To do this, diachronic evidence comparing the development and socialization of one generation with that of the next is required.

In taking up these issues of the connection between history and individual development, it is important to consider how, methodologically, to connect macro conditions on the societal level to the micro level of individual development and socialization. We use both quantitative and qualitative analyses to demonstrate the relationship of the macro conditions of a society undergoing ecocultural change to the micro level of individual development and behavior.

RESULTS FROM OUR STUDY OF THE FIRST GENERATION OF WEAVERS

In the first video study of informal education in a nonindustrial society, Childs and Greenfield (1980) looked at the interactional processes involved in the transmission of weaving skill from one generation to the next in Zinacantán. This study was a sequel to another in which the authors compared the cognitive consequences of weaving, the most complex skill acquired by Zinacantec girls, with those of formal schooling, received predominantly by boys at the time the data were collected (Greenfield & Childs, 1977).

In 1969 and 1970, weaving instruction in Zinacantán was characterized by a relatively error-free scaffolding process based on observation of models, obedience to developmentally sensitive commands, and use of help when needed (Childs & Greenfield, 1980; Greenfield, 1984). This mode of informal instruction was well adapted both to the superordinate Zinacantec goal of preserving the *baz'i*, or "true" (i.e., traditional Zinacantec) way of life (Greenfield & Lave, 1982), and to the innate nature of Zinacantec children (Brazelton, Robey, & Collier, 1969). In terms of developmental theory, weaving apprenticeship followed a Vygotskian model of learning, with its emphasis on guidance by a more skilled "other" (Vygotsky, 1978).

In weaving, the "true" way involved learning to construct the repertoire of only four traditional Zinacantec patterns. Pattern innovation and the creation of new patterns were simply not a part of the culture or the transmission process. In 1969 and 1970, the

transmission of weaving skill was a relatively error-free, scaffolded process. Teachers stayed close to their pupils and prevented errors before they happened.

In the intervening two decades since the first weaving data were collected, profound social change has occurred in Zinacantán. Many Zinacantecs have become entrepreneurs, joining the modern Mexican economy (Cancian, 1990). The community is in the process of a transition from agriculture and a subsistence economy to commerce, entrepreneurship, and cash. Both men and women have become involved in the new cash economy. Some men who formerly farmed are now involved in the transport business, running a van service back and forth to the former colonial city of San Cristobal de las Casas. Some girls and women weave and embroider *servilletas*, pieces of cloth suitable for use as placemats by tourists and other outsiders who buy them.

Whereas the method of apprenticeship practiced in 1969 and 1970 was adapted to transmitting a tradition intact, another method of apprenticeship, trial-and-error learning, with its emphasis on the learner's own discovery process, should foster the development of an ability to innovate. If innovation had, in fact, entered the culture as a value orientation in response to or as part of commercial entrepreneurship, we thought that weaving education would make a corresponding shift. Earlier, the teacher had carefully built a scaffold of help for the learner, providing help before the learner had an opportunity to make a serious error. Because the learner, in this situation, was afforded very little opportunity to make a mistake, let alone to explore, we predicted that the methods of teaching and learning would change to a more independent trial-and-error approach. From the point of view of developmental theory, this is the model of learning emphasized and valued by Piaget (1965/1997). Independence could also come from having a mother engaged in her own commercial activity. A mother might, for example, use her time to create a commodity to sell, assigning another daughter to teach the younger one how to weave.

Our study of the effects of cultural change on developmental processes has three parts. In the first part, we present our qualitative data on the changes in the woven artifacts. We predicted that the shift toward entrepreneurship would engender greater innovation in Zinacantec woven artifacts, and this prediction was confirmed. We also predicted that greater innovation would be

preceded by a different socialization pattern, one not oriented to the maintenance of tradition. This prediction was confirmed by the results of the second part of our study: We show, using qualitative and quantitative data, how informal weaving apprenticeship at home moved from a more controlled, interdependent style to a more independent, trial-and-error style. In the third part, we present both qualitative and quantitative findings from studies of Zinacantecs' representations of woven patterns, linking changes in representation to economic movement away from subsistence and toward commerce.

FROM TRADITION TO INNOVATION: THE CREATION OF ARTIFACTS

Innovation was in sharp contrast to the values and practices observed in Zinacantán in 1969 and 1970. At that time, tradition, rather than innovation, was valued; there was but a single *baz'i*, or "true way," to do everything, from speaking to dressing.

In 1969 and 1970, woven artifacts, like other parts of the culture, were stable and unchanging, limited by tradition. Woven patterns were limited to two red-and-white striped configurations, one multicolor stripe, and one gray-and-white basket-weave pattern. Figure 1 shows two Zinacantec boys dressed alike in 1970. Indeed, in 1970, all males dressed virtually alike; for example, these two boys are wearing red-and-white striped ponchos in the only available pattern with no distinctive embroidery. By 1991, each poncho had unique, innovative elements of design. Two examples, each with different brocaded designs along the lower edge (Figures 2a and 2b) and elaborate embroidered designs on each side (Figure 2a), reflect a contemporary trend of pattern innovation. No two pieces of clothing or other woven items were alike in their brocaded and embroidered designs. We saw both new motifs and new recombinations of old motifs.

Although the garments were now unique, one element remained the same—the configuration of the red-and-white background stripe (see Figure 2b, top). However, the ratio of red to white had increased dramatically. (The red and white background stripe of the poncho was an important stimulus in the pattern representation experiment described in the last section.)



Figure 1: Two Brothers Wearing the Zinacantec Poncho, 1970

NOTE: The ponchos are red-and-white striped, with white predominating (see Figure 6, top). Photo courtesy of Sheldon Greenfield.

FROM INTERDEPENDENCE TO INDEPENDENCE: APPRENTICESHIP METHODS

Based on our research in 1969 and 1970, we concluded that the goal of Zinacantec education and socialization was the intergenerational replication of tradition: Learning to weave meant learning to weave a few specific patterns. Because tradition was maintained by a more controlled apprenticeship process, with the teacher guiding the pupil very closely, we predicted that innovation would be the result of a less controlled, less guided apprenticeship process, in other words, a more independent process. Our focus for studying changes in apprenticeship methods was on the learning processes involved in the important cultural technology of weaving, the most complex skill in the culture, a skill acquired by virtually all Zinacantec females.



Figures 2a and 2b: Two Different Zinacantec Ponchos, 1991

NOTE: Figure 2a shows the whole garment with embroidered flowers on two sides and a bottom band of brocade-woven deer. Figure 2b is a detail from another poncho showing a bottom band of brocade-woven flowers. The background is a red-and-white stripe. Note the high ratio of red to white in the fringe of each poncho. Photos courtesy of Lauren Greenfield.

Recall that the particular way in which weaving was taught in 1969 and 1970 fostered the goal of maintaining tradition: The learning process was a relatively error-free one in which the teacher, usually the mother, sensitively provided help, models for observation, and verbal direction in accord with the developmental level of the learner. The mother provided a scaffold of help that allowed the learner to complete a weaving she could not have done by herself. There were no failures; every young girl successfully learned to weave. Because the process was highly structured by the older generation and did not allow room for learner experimentation and discovery, the method of informal education (or apprenticeship) was, as mentioned earlier, well adapted for the continuation of tradition and the status quo. In the 1991 and 1993 data, we expected to see more trial-and-error learning, with the learner spending more time weaving unassisted and having to ask for help herself.

METHOD

Participants

The participants were 72 Zinacantec girls, ranging in age from 3 to 19 (mean = 11.8, median = 12). The first generation of girls was observed learning to weave in 1970. The second generation, virtually all daughters, nieces, and goddaughters of the first generation, was mainly observed in 1991. Two descendents of the original sample, too young to weave in 1991, were observed in 1993. The girls had varying experience in learning to weave. For some girls, the videotaped session in our protocol was their very first weaving session. Others had woven various items before, ranging in difficulty from very low to very high. Participants were recruited in two ways: by a Zinacantec research assistant, Xun Pavlu, who visited people he knew in the community and asked them to participate, and by word of mouth, as people in the community began to know the researchers and feel comfortable with them.

Procedure

Participants were videotaped for one hour in front of their homes (or inside if it was raining). Participants and their mothers were interviewed about the girls' experience in weaving. A more

extensive description of the procedures is presented in Greenfield, Maynard, and Childs (1999). The medium of communication between researchers and participants was the Maya language of Tzotzil.

Coding of the Videotapes

The videotapes were extensively coded by Childs. One major variable of interest in this article is the proportion of time in which learner and teacher were engaged in collaborative weaving activity. This was defined as the proportion of time the learner and teacher/helper were observed working together. For this article, we measured collaborative activity during two segments of the weaving process that are relatively difficult to carry out: attaching the endstick (for woven items that do not have fringe and must therefore be woven to the end of the warp threads), and the first cycle of weaving (the first time a weft thread is inserted into the warp). For learners who attached an endstick during their video observation, we used this segment for our measure; for learners who were making fringed items and therefore did not attach an endstick, we used the first cycle of weaving for our measure. A second measure of interest was the extent of the learner's observational activity; this was defined as time spent observing the teacher demonstrate some aspect of the weaving process.

Interrater reliability for these measures had been established by Childs and Greenfield (1980), based on the 1970 study. However, for the historical comparison presented in this article, Childs recoded all of the 1970 videotapes, as well as coding the 1991/1993 data; this recoding of the old data prevented "historical drift" in the coding process and ensured that the old and new videos were coded in exactly the same way.

New interrater reliability was also established. Interrater reliability for collaborative weaving activity and learner observation was based on a random sample of eighteen weaving segments from eighteen learners. Greenfield served as the reliability coder. The correlation between the two coders for proportion of collaborative weaving activity was .8872 ($p = .000$); for proportion of learner observation, the correlation was .9703 ($p = .000$).

Another variable of interest in the current article was the generational status of the teacher. This was a 4-point scale: *no helper*, *helper younger than the learner*, *helper in same age cohort as*

learner, helper in older generation than learner. Generational status of the teacher/helper was coded from the video record aided by notes taken at the time of the observation, familiarity with the weavers and their families, and family tree records.

Textile Commerce Scale

To assess mothers' and daughters' experiences in textile commerce, we used our own interview data supplemented by access to a survey of the community carried out in 1991 by the Stanford Medical Project. From these data sources, we created a textile-commerce scale. Mother-daughter textile commerce scores are an additive composite of various binary items: for example, whether either mother or daughter sold her weavings, whether daughter wound balls of thread for wages, or whether mother or daughter worked in a family retail store selling thread.

RESULTS

Qualitative Results

The 1970 video data reveal a highly structured apprenticeship method. Katal Pavlu, age 9, is one example of a girl learning to weave. In the videotape of Katal's learning session, we first see Katal there by herself. Very soon after the tape starts, her mother enters to help on her own initiative, without being summoned by her daughter. Her mother is very much there, continuously helping or doing part of the weaving for her daughter. This type of involved participation is illustrated in a frame from the videotape, shown in Figure 3. In the video frame, four hands on the loom symbolize the closely assisted style of weaving apprenticeship typical of the era.

Katal grew up and had daughters of her own. In the video of her daughter, Loxa Santis, learning to weave 21 years later, also at about age 9, we see a style of teaching geared more toward independent learning (see Figure 4). In the video of Loxa learning to weave, her mother is not there at all to help her. This might be because she is busy embroidering a blouse sold on order to one of the researchers; this is an example of textile commerce. In addition, Figure 4 illustrates that the teacher no longer comes from the older generation; it is Loxa's older sister, Xunka', a member of the peer generation. Although Xunka' is the teacher, she is paying



Figure 3: Four Hands on the Loom: Xunka' Helps Her Daughter, Katal Pavlu

NOTE: Nabenchauk (1970), video by Patricia Greenfield.

little attention to the learner (note the direction of the teacher's visual attention in Figure 4, away from the learner). Indeed, Loxa, the learner, has to call Xunka' several times, taking the initiative to get her attention. We see, in the diachronic study of one family over two generations, how learning has moved from a more interdependent style of apprenticeship to a more independent style of apprenticeship.

Quantitative Results

But how general is this historical case study? Its generality was confirmed by the quantitative analysis of our entire sample of weaving learners from both historical periods. Using structural equation modeling as our primary means of statistical analysis, we demonstrated the predicted relationship between historical period and learner independence-interdependence. Moreover, as



Figure 4: Katal Pavlu's Daughter, Loxa Santis, Learns to Weave 21 Years Later

NOTE: Loxa is about the same age as her mother was in Figure 3. Her teacher is her older sister, Xunka' Santis. Nabenchauk, 1991, video by Patricia Greenfield.

predicted, this relationship was mediated by mother and daughter's participation in textile-related commerce. Figure 5 shows how participation in textile-related commerce creates a pathway by which historical period, a very distal variable, influences collaboration, a proximal variable in cultural apprenticeship, through the mediation of involvement in textile commerce. The model shows that from one historical period to the next, participation in textile-related commerce increases significantly (a positive link of .38 between historical period and textile commerce, significant at the .01 level). More involvement in textile-related commerce led, in turn, to less collaborative activity between learner and teacher (a negative link of .28 between textile commerce and collaboration, significant at the .05 level); in other words, it led to a decrease in learner-teacher interdependence.

In line with our diachronic case study, the relationship between the generational status of the teacher/helper and the amount of collaborative activity also generalized to the sample as a whole. In

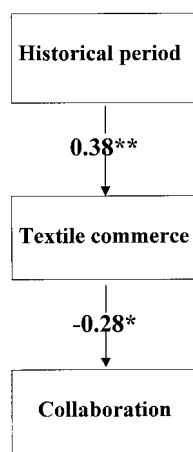


Figure 5: Path Diagram of Relationship Among the Variables of Historical Period, Mother-Daughter Involvement in Textile Commerce, and Teacher-Learner Collaboration

NOTE: *Parameter is significant at the .05 level. **Parameter is significant at the .01 level. Using EQS (Bentler, 1980, 1995) with maximum likelihood estimation, we found a good fit between model and data. The comparative fit index (CFI) for the tested model was 1.000, and the model chi-square was nonsignificant, $\chi^2 = .029, p = .8659$. (For the CFI and chi-square test, good fit is indicated by a value greater than .90 and by nonsignificant results, respectively. A CFI of 1 is the maximum possible). The model includes all weaving participants videotaped attaching the endstick or weaving the first weft thread ($N = 69$).

other words, just as Katal's mother provided more collaborative help to Katal in 1970 than Loxa's older sister provided to Loxa in 1991, so too there was an overall significant correlation between the generational status of the teacher and amount of collaborative weaving between teacher and learner.¹ This result indicated that older teacher/helpers (who were also more skilled weavers) provided more collaborative assistance to weaving learners than younger teacher/helpers did. In other words, on the average, a mother would provide more collaborative help to a weaving learner than an older teenage sister, who would, in turn, provide more collaborative help to the learner than a younger cousin.

There was additional evidence of an increase, from 1970 to the 1990s, in learner independence and trial-and-error learning. Between the first and second generation of learners, we found a significant increase in the proportion of time learners spent working

independently (attaching the endstick without help from the teacher)² and a significant decrease in the proportion of time learners spent watching their teachers demonstrate this part of the weaving process.³ Together, these findings paint a picture of an increase in learner independence and trial-and-error experimentation from 1970 to the 1990s.

Discussion

These findings indicate that changes in apprenticeship accompany changes in the ecocultural milieu. Our path model demonstrates the relationships among the variables, from the distal variable of historical period to the experiential variable of mother-daughter participation in textile commerce to the most proximal variable of teacher-learner collaboration. Other analyses showed that in the 1990s, weaving learners spent more time working independently and less time observing a model provided by the teacher than their mothers, aunts, and godmothers had when they learned to weave in 1970. On a theoretical level, our findings indicate that processes of scaffolded guidance (the processes emphasized by Vygotsky, 1978) are emphasized more when cultures are in a more stable, tradition-maintaining state. In contrast, processes of independent trial-and-error experimentation (the processes emphasized by Piaget, 1965/1977) are used more when cultures are in a more dynamic, innovation-oriented state.⁴ As the Zinacantecs moved from one state to the other in our time slice of two decades, the emphasis in their modes of cultural learning changed accordingly. However, change was uneven. As predicted, it was most concentrated in those families who had made the greatest shift to a commercial way of life.

FROM SPECIFICITY TO ABSTRACTION: SYMBOLIC REPRESENTATION

Subsistence involves exchanges and contributions of very specific items. In sharp contrast, a cash economy involves the abstraction of money, which is a totally generalized medium of exchange. Our study of the shift from specificity to abstraction focuses on participants' ability to represent Zinacantec woven patterns. Our hy-

pothesis was that the historical increase in commerce and use of money would lead to an increase in abstract (as opposed to detailed) representation of woven patterns. We also thought that this historical shift would be mediated by commercial involvement.

METHOD

Participants

Participants were 202 Zinacantec children and young adults, ranging in age from 3.5 to 22, with a mean age of 11.54 years. Participants were recruited by the same Zinacantec assistant as in the study of weaving apprenticeship, Xun Pavlu.

Materials

Materials included a wooden frame and sticks that could be arranged in striped patterns inside the frame. The sticks were available in three widths—narrow, medium, and broad. In each width, sticks came in several colors, including pink, orange, red, and white. In addition, participants were provided examples of Zinacantec woven items, one male poncho and one female shawl; they were asked to use the sticks to represent the poncho and the shawl. The poncho (such as was shown in Figure 1) and shawl each had a distinctive configuration of stripes. The male pattern contains a simple red-and-white stripe, whereas the female pattern contains a more complex red-and-white stripe. Examples of each configuration, circa 1969, are shown in Figure 6. The particular items to be represented were whatever the participant was wearing (shawl if a girl, poncho if a boy), plus another contemporary standard example from the clothing of the opposite sex.

Procedure

Participants came to the home of a Zinacantec family to be individually tested on the pattern representation procedure. Each participant was asked to use the colored sticks to represent two patterns, the pattern for the men's poncho and the pattern for the women's shawl (see Figure 6). (Additional pattern representation tasks are analyzed in Greenfield, Maynard, & Childs, 1999.)

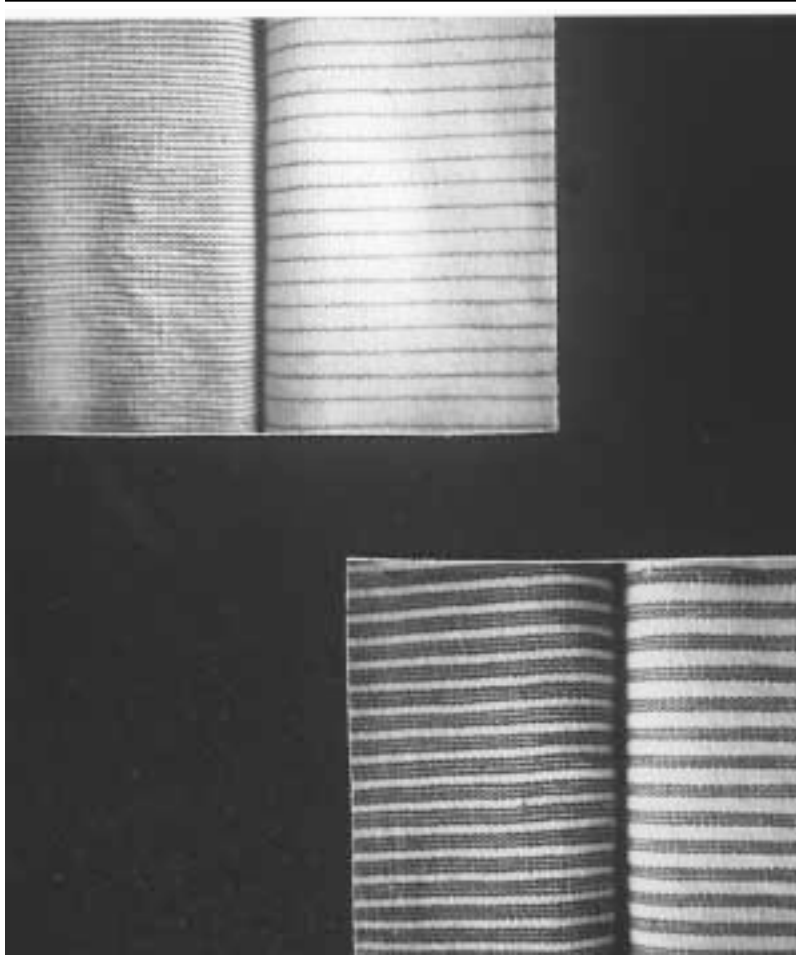


Figure 6: Striped Configuration for Male Poncho (upper left), Striped Configuration for Female Shawl (lower right)

NOTE: Two examples of each red-and-white stripe pattern are shown (photo by Carla Childs).

Family Commerce Scale

Because we had both boys and girls in the data set, we made a scale of family participation in nontextile commerce. Like the textile commerce scale, this scale was derived from interview and census data. Almost all items could equally apply to boys or girls. The

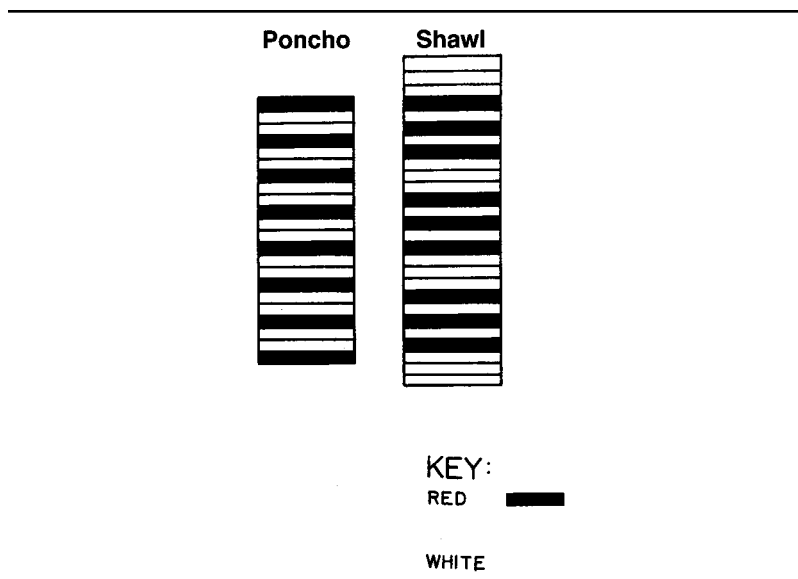


Figure 7: Detailed Representation of Poncho and Shawl

scale included such items as the family owning a television, working in a local shop, and selling peaches.

RESULTS

Styles of Representation in 1969 and 1970

Detailed representation. Skilled weavers often produced an accurate analysis of the configuration of stripes (Greenfield & Childs, 1977). Their analytic representations were always specific or detailed: Each thread in a broad stripe was represented by a separate, thin stick, just as a weaver would construct a broad stripe out of putting together several individual threads (see Figure 7). The accuracy of the pattern analysis can be seen by comparing the configurations of red-and-white stripes constructed in the experiment (see Figure 7) with the actual woven patterns (see Figure 6).

Abstract representation. Figure 8 shows an abstract representation of the same woven patterns. This is a style of representation never used by the 1969 and 1970 Zinacantec weavers but used by

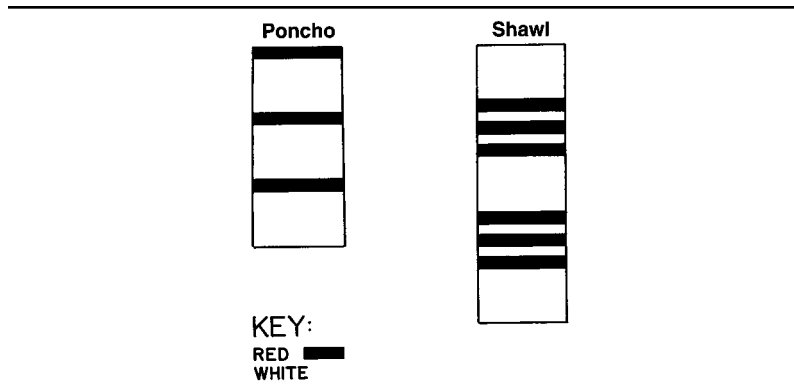


Figure 8: Abstract Representation of Poncho and Shawl

U.S. college students (Greenfield & Childs, 1977). Like Zinacantec weavers, these college students carried out an accurate, analytic representation of the configuration of stripes (compare Figure 8 with the actual woven patterns in Figure 6). However, this representation uses a single broad stick for a broad stripe rather than combining several narrow ones into a single stripe. As a representation of the two patterns, this strategy is equally accurate. However, it is less specific or detailed, thus more general or abstract.

Styles of Representation in 1991

Detailed representations showing a line-by-line or thread-by-thread construction of the patterns remained in 1991. However, many participants used the abstract style, as depicted in Figure 8. Abstraction had been added to analysis of the woven patterns. Our hypothesis was that it was participation in the money economy, with its abstract medium of exchange, that caused this change to a more abstract and less detailed style of representation.

Quantitative Analysis

The historical change toward increasingly abstract representation and the role of commercial involvement in this shift were tested by means of structural equation modeling. The structural equation model (Greenfield, Maynard, & Childs, 1999) confirmed our hypotheses that there was a historical shift from detailed to abstract representation of the woven patterns and that this shift

was mediated by involvement with commerce. For the purpose of creating a quantitative variable that could be used in a structural equation model, abstract representation was based on the number of medium and broad sticks (as opposed to thin sticks) used to represent stripes in the poncho and shawl. The model showed that from one historical period to the next, participation in nontextile commerce increased and that this increase led, in turn, to a more abstract mode of representation. Although we tend to associate both formal schooling and maturational age with the development of abstraction, the Wald statistical test indicated that neither of these variables contributed to mediating the historical increase in abstract visual representation.

DISCUSSION

Our results indicate that ecocultural patterns affect the cognitive representation of cultural artifacts. That is, those Zinacantec children whose families were more involved in commercial activity tended to show a more abstract style of representing the woven patterns they were presented. Representational style is not a static quality of a given population. Instead, representational style can change and adapt in the face of changing ecocultural conditions.

GENERAL CONCLUSIONS

The diachronic study of ecocultural change has reaped rich rewards: It reveals theoretical and empirical links between individual processes of cultural apprenticeship and societal processes of cultural change. Our qualitative and quantitative findings point to a process of reciprocal change in which societal conditions provide an ecological push toward new modes of cultural apprenticeship, as new modes of apprenticeship create a younger generation with the skill profile appropriate to the changed societal conditions.

Our findings indicate that processes of cultural learning and cultural transmission change as cultures change over time. Based on our earlier analysis, we predicted that socioeconomic changes in the culture would be accompanied by a change in the cultural goals of socialization—that innovation would begin to replace conformity to tradition and, most important for this study, that informal

education would reflect the changing value system by coming to rely more on trial-and-error methods, less on demonstration and help (Greenfield, Brazelton, & Childs, 1989).

We have found that the Zinacantecs used scaffolded guidance in weaving apprenticeship when they were in a more stable, tradition-maintaining state. In contrast, they used more independent, trial-and-error learning when they moved to a more dynamic, innovation-oriented state. As predicted, the teaching style associated with innovation and independence was used more in those families who had made a greater shift from agriculture to commerce.

Sociocultural forces on the macro level affected the process of cultural apprenticeship on the micro level. Changes in processes of cultural apprenticeship produced a new generation that was well adapted to the changed ecological niche. In other words, there was a tight relationship between a changing ecological niche and a changing developmental niche (Super & Harkness, 1986).

One aspect of this adaptation was changes in the creation of cultural artifacts. With the shift from a more interdependent to independent style of weaving apprenticeship, girls had the independence to be more creative in their weaving, going outside the traditional frameworks of what a woven piece of clothing should look like and innovating with new designs and colors.

At the same time, commerce itself was a socializing force that affected cognitive representation. As the economy moved from subsistence to money-based commerce in our window of two decades, styles of representing textiles became more abstract and less tied to the detailed way in which the textiles were created. Our quantitative analysis showed that this change in representational style was mediated by participation in the commercial economy.

Our diachronic study is a kind of longitudinal study on the family, rather than individual, level. This new methodology was able to demonstrate links between cultural change, variability in the production and representation of cultural artifacts, and the apprenticeship process by which people learn to produce those artifacts. When the Zinacantecs were in a more homogeneous, agriculture-based ecocultural pattern, socialization processes fostered a continuance of tradition and a more specific style of representation. As many families moved to a more commercial, money-based ecocultural pattern, socialization processes changed to stimulate independent learning, innovation, and abstraction.

Notes

1. $r = .3152$; $p = .026$, two-tailed test; $n = 50$. This correlation is based on all weaving learners who had teachers or helpers.
2. One-way analysis of variance, $F(1, 58) = 5.0793$, $p = .0280$.
3. One-way analysis of variance, $F(1, 58) = 11.1965$, $p = .0014$.
4. The link to Piaget and Vygotsky was suggested by R. Gelman (personal communication, 1991).

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